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TASC ASTT TECHNICAL AND MANAGEMENT MONTHLY PROGRESS REPORT

Progress Report for the Period:

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1. INTRODUCTION

This report provides a summary of the progress made during the report period under TASC's three ASTT (Advanced Simulation Technology Thrust) projects:

- MRA (Multiresolution Analysis), CLIN 0001/0002, Whitney
- JETS (JSIMS Environmental Tailoring), CLIN 0003/0004, Ouzts
- FROST (Framework of Reusable Objects), CLIN 0005/0006, Stanzione.

This report contains both Technical (Section 2) and Management / Financial (Section 3) status information, reported individually for each of the three projects.

2. TECHNICAL SUMMARY

2.1 MRA - MULTIRESOLUTION ANALYSIS (CLIN 0001/0002)

2.1.1 Technical Accomplishments

Responding to a request from the government, MRA produced a deliverable document, "MRA (Muliresolution Analysis) Research Program Experiment Plan" that provided a comprehensive summary of the background and motivation for our experimental approach. This document was a follow-up to the oral presentation we made during March. While preparing this report, we began detailed planning for the second phase of our Land Warfare Experiment.

To support this next experiment, we requested and received six high-resolution terrain databases from TEC. We learned of these data during our government review in March and appreciate the rapid response to our request. Using these data will enable us to avoid data interpolation, as was used for our earlier work, with its uncertain impact on the analytical results.

In an appendix to the document mentioned above, we supplied details of our development of a general approach to defining MOCs for categorical simulated variables. We emphasized the parallels between the consistency questions addressed by MRA and the weather forecasting skill issue that motivated the original formula. This class of MOCs is the first example of one of the key MRA outputs: MOC formulas and algorithms, each applicable to a large class of simulated

variables. We next intend to refine and publish general formulas for ordinal variables, then for continuous-valued scalar variables.

2.1.2 Results Obtained Related to Previously Identified Problem Areas

Not applicable.

2.1.3 Technical or Schedule Problem Areas

Since David Whitney will be leaving TASC early in May, Dr. Charles Medler will assume the Principal Investigator role for MRA. This will cause no disruption in our work as Dr. Medler has been working on MRA almost full time for several months. In addition, we will be expanding the project team to include Forrest Chamberlain and Victor Skowronski, both experts in terrain-related simulation issues, who will lead development of the next phase of the Land Warfare Experiment.

2.1.4 Activities Planned for the Next Reporting Period

During May, MRA will develop and publish a detailed plan for the second phase of the Land Warfare Experiment. We will be coordinating this plan with the MRM project as there are several points of exchange, especially later in the experiment activities.

2.2 JETS - JSIMS ENVIRONMENTAL TAILORING SERVICES (CLIN 0003/0004)

2.2.1 Technical Accomplishments

The team developed a detailed experimental approach for the development, implementation and testing of numerical tailoring algorithms for JETS. The plan includes a staged approach beginning with development of the simplest techniques (blending, merging) to more sophisticated ones (correlated field editing, NWP modeling). We will present our progress on each of these techniques in the Preliminary Numerical Tailoring Algorithm Report in July 1998. By that time, we anticipate we will have largely completed experiments testing the blending and merging

techniques and will have some preliminary insight into the more advanced techniques. An outline of our plan follows.

JETS EXPERIMENTAL PLAN

Simple Merging and Blending Techniques

These techniques involve a statistical approach to performing edits on a Synthetic Natural Environment (SNE). Merging involves combining two self-consistent scenarios. The combined scenario will no longer be physically consistent. Various statistical techniques can be used to merge scenarios. Blending involves an edit made to one or more variables at one time and one region within a SNE. Issues of physical consistency are relevant in both time and space when blending is performed.

1. Merging scenarios
   - 1.1 Develop techniques for merging (in one or more time steps) two physically consistent scenarios
     - 1.1.1 Simple blending
     - 1.1.2 Statistical blending
     - 1.1.3 Gradient blending
     - 1.1.4 Other techniques
   - 1.2 Issues of consistency for interim merged variables
     - 1.2.1 Spatial
     - 1.2.2 Temporal

2. Blending scenarios
   - 2.1 Develop techniques for blending (at one time) a single variable
     - 2.1.1 Simple blending
     - 2.1.2 Statistical blending
     - 2.1.3 Gradient blending
     - 2.1.4 Other techniques
   - 2.2 Issues of consistency
     - 2.2.1 Spatial
     - 2.2.2 Temporal

4-D Gridded Variable Alteration Techniques

Various techniques have been developed within the operational community for altering the output of Numerical Weather Prediction (NWP) models. These techniques employ physical equations governing the mass, moisture, and movement of the atmosphere and are thus physically-based rather than statistically-based editing methods. For JETS, we will need to enhance these methods because they were developed to edit a limited set of parameters.

3. UK Meteorological (UKMet) Office Techniques
   - 3.1 Application to specific variables
   - 3.2 Extension to additional variables for JETS

4. National Weather Service (NWS) techniques
   - 4.1 Application to specific variables
   - 4.2 Extension to additional variables for JETS

Use of NWP Models for Tailoring
NWP models may be used to enhance our understanding of the impacts of editing gridded volumetric variables. We may also look to the future as NWP models may be employed in a real-time simulation training system. Here we will investigate techniques for "nudging" a model towards a desired outcome. The NWP model is an excellent tool for such an investigation in that it supplies us with the "ground truth database" as well as the "perturbed" ground truth upon the application of an edit. We can compare the results to study the spatial and temporal impacts of an edit on an SNE.

5. Wave-based Alteration Technique
   5.1 Definition of SNE edit as wave with amplitude and spatial extent
   5.2 Determination of vertical profile of edit advection
   5.3 Specification of dissipation time scale

6. The Future: Real-time NWP Model Alteration
   6.1 Use of model nudging at boundaries
   6.2 Use of local forcing
   6.3 Manipulation of physical constraints
   6.4 Employment of adjoint techniques and sensitivity analysis

Multi-Resolution Issues in Tailoring
When an edit is made to a SNE, one must consider whether that edit will be communicated to models of various resolutions and fidelity in a consistent manner. Using gridded SNE databases at multiple resolutions, we will study the impact of downsampling from high resolution as well as interpolation from low resolution data. We may employ various measures from the MRA project to quantify our results.

7. Multiple resolution SNE gridded fields
   7.1 Resolution requirements
   7.2 Methods for retaining high resolution information
   7.3 Methods for interpolating low resolution data

We are establishing contact with the National Weather Service (NWS) in an attempt to provide us with current operational algorithms for editing forecast fields. We believe the methods used by the NWS are similar to UK Met Office editing techniques. To learn more, we are attempting to gather literature and establish a dialogue.

2.2.2 Results Obtained Related To Previously Identified Problem Areas

Not applicable.

2.2.3 Technical or Schedule Problem Areas

None.

2.2.4 Activities Planned for the Next Reporting Period

We will begin to develop and test merging and blending scenarios (Experimental Plan 1,2) using Synthetic Natural Environments (SNE) created with the NCAR/PSU Mesoscale Model Version 5 (MM5). "Merging" involves bringing together two independent SNEs at one time and involves many issues including various statistical methods for joining the scenarios as well as appropriate methods for transitioning the edits in time. "Blending" involves the placement of a perturbation to one or more variables within an SNE. All of the issues present in merging scenarios apply to blending as well. In addition, we must investigate appropriate methods for correlating the edited field with other "unedited" variables at the same time and blending all fields in space and time.

2.2.2 Results Obtained Related To Previously Identified Problem Areas

Not applicable.

2.2.3 Technical or Schedule Problem Areas

None.

2.3 FROST - FRAMEWORK OF REUSABLE OBJECTS (CLIN 0005/0006)

2.3.1 Technical Accomplishments

Tom Stanzione, Alan Evans, and Forrest Chamberlain continued to refine the architecture reported last month. Todd Shannon, Andrew Gronosky, and Eric Yee are working to implement this architecture as the FROST prototype. The team has been working on the low level object model to implement this architecture, including the definition of classes and methods to implement the GTED and ASED components. Forrest developed a strawman design for the GTED server, and Todd developed the design for the ASED client. Andrew is implementing the version database that is a necessary component for FROST to handle time management. Eric has implemented a simple GTED/GTEMs using ObjectStore for the development effort. He is currently working on a simple viewer application to use as a client simulation application to test

the implementation as it develops.

Eric Yee and Howard Lu completed the evaluation of Oracle, ObjectStore, and Objectivity. We have selected ObjectStore to use as the object oriented database management system for the FROST prototype. A letter to DARPA has been sent to request permission to purchase this software for the project. Tom Stanzione, with inputs from the rest of the team, continued working on the Environmental Interface Specification.

Tom, Alan, and Forrest participated in a teleconference with Jon Watkins, who is one of the lead SNE developers for JSIMS. This meeting was very informative. The discussion centered on JSIMS and FROST compliance with the JISMS architecture. There was also a discussion at the end on the Encapsulated Coordinate System (ECS). They agreed that there are errors in JSIMS Tech Note 11, para 2.3.1.4, or at best a serious ambiguity. The sentence "In particular, SNE objects which are unchanging... instead encapsulated within the CI component known as Common Services." We agreed on:

(1) FROST EI as a whole should be part of the Common Services and not provide FOs.

(2) In order to provide information about a dynamic SNE through Common Services, therefore, more than static SNE data would be encapsulated within Common Services. Else, no queries or effects models can be run against dynamic data, which obviously doesn't make sense.

(3) Static (we prefer quiescent) data will be transmitted by a mechanism other than the MMF of course. This is what our COTS integration is all about.

2.3.2 Results Obtained Related to Previously Identified Problem Areas

Not applicable.

2.3.3 Technical or Schedule Problem Areas

None.

2.3.4 Activities Planned for the Next Reporting Period

We will continue to refine the FROST architecture and continue the implementation of the prototype. We will continue to use Rational Rose to capture the object-oriented design of the FROST prototype. We hope to have a simple end-to-end query from GTED data compiled into ASED data and flowing through a server-side ASED implementation. We will complete the Environmental Interface and determine the requirements for the SEDRIS transmittal necessary for the prototype GTED. We will also continue to prepare for the FROST peer review scheduled for early June.

3. MANAGEMENT AND FINANCIAL SUMMARY

3.1 MRA (CLIN 0001/0002)

3.1.1 Cost Element Problem Areas

None.

3.1.2 Program Financial Status*

Work Breakdown Structure or Task Element	Cumulative to Date ($)** Planned Expend	Actual Expend	% Compl	At Completion ($)*** BAC	LRE	Remarks
TOTAL FY97-99 CLIN 0005/0006	415,950	461,839	29.6%	1,560,746	1,560,746	

*** Includes both funding in-hand (FY 97-98) and planned (FY 99).**
**** Excludes cost of money.**
***** Excludes fee and cost of money.**

Expenditures for FY 1998 by Month:

	Dec 98	Jan 98	Feb 98	Mar 98	Apr 98	May 98	Total To Date	FY 98 Total
Planned	$63,000	$33,850	$33,850	$33,850	$33,850	$67,700	$266,100	
Actual	$74,250	$40,850	$46,932	$56,926	$56,542		$275,500	

	Jun 98	Jul 98	Aug 98	Sep 98	Oct-98	Nov-98		
Planned	$67,700	$67,700	$67,700	$67,700	$101,550	$101,550	$473,900	$740,000
Actual								

Based on currently authorized work:

(1)	Is current funding sufficient for the current FY	Yes
(2)	What is the next Fiscal Year's funding requirement at anticipated levels	$720K
(3)	Have you included in the report narrative any explanation of the above data and are they cross-referenced?	No

3.1.3 Travel and Meetings

Date	Location	Subject
Various	Teleconference Chuck Medler David Whitney	Numerous exchanges with Larry Willis, Ralph Toms, Paul Birkel, Robert Knox (WARSIM) and the Maritime EA relating to development of the MRA Research Program Experiment Plan.

3.1.4 Any Significant Changes to the Contractor Organization or Method of Operation

None.

3.1.5 Summary of Engineering Change Proposal (ECP) Status

None.

3.2 JETS (CLIN 0003/0004)

3.2.1 Cost Element Problem Areas

None.

3.2.2 Program Financial Status*

Work Breakdown Structure or Task Element	Cumulative to Date ($)** Planned Expend	Actual Expend	% Compl	At Completion ($)*** BAC	LRE	Remarks
TOTAL FY97-99 CLIN 0003/0004	204,675	258,864	29.7%	871,413	871,413	

*** Includes both funding in-hand (FY 97-98) and planned (FY 99).**
**** Excludes cost of money.**
***** Excludes fee and cost of money.**

Expenditures for FY 1998 by Month:

	Dec 98	Jan 98	Feb 98	Mar 98	Apr 98	May 98	Total To Date	FY 98 Total
Planned	$36,500	$12,725	$12,725	$12,725	$12,725	$25,450	$112,850	
Actual	$24,241	$28,875	$20,808	$30,305	$24,635		$128,864	

	Jun 98	Jul 98	Aug 98	Sep 98	Oct-98	Nov-98		
Planned	$25,450	$25,450	$25,450	$25,450	$38,175	$38,175	$178,150	$291,000
Actual								

Based on currently authorized work:

(1)	Is current funding sufficient for the current FY	Yes
(2)	What is the next Fiscal Year's funding requirement at anticipated levels	$500K*
(3)	Have you included in the report narrative any explanation of the above data and are they cross referenced ?	No

***Reflects guidance received at February IPR to expect $500 K in FY 99.**

3.2.3 Travel and Meetings

Date	Location	Subject
7 Apr 98	Teleconference Dr Pete Dailey	Discussed National Weather Service's (NWS) program to begin a forecast Output modification program with Dr David Ruth

3.2.4 Any Significant Changes to the Contractor Organization or Method of Operation

None.

3.2.5 Summary of Engineering Change Proposal (ECP) Status

None.

3.3 FROST (CLIN 0005/0006)

3.3.1 Cost Element Problem Areas

We are spending more that we planned based on the requests to investigate the JSIMS and RTI architecture implications of FROST. These costs were not anticipated and may result in decreased functionality in the prototype. We will also run out of funds this fiscal year before we can receive next fiscal year funds if we continue to spend at this rate.

3.3.2 Program Financial Status*

Work Breakdown Structure or Task Element	Cumulative to Date ($)** Planned Expend	Actual Expend	% Compl	At Completion ($)*** BAC	LRE	Remarks
TOTAL FY97-99 CLIN 0005/0006	329,765	$416,320	36.9%	1,128,752	1,128,752	

*** Includes both funding in-hand (FY 97-98) and planned (FY 99).**
**** Excludes cost of money.**
***** Excludes fee and cost of money.**

Expenditures for FY 1998 by Month:

	Dec 98	Jan 98	Feb 98	Mar 98	Apr 98	May 98	Total To Date	FY 98 Total
Planned	$101,000	$21,450	$21,450	$21,450	$21,450	$42,900	$229,700	
Actual	$84,482	$30,779	$51,066	$56,645	$49,704		$178,568	

	Jun 98	Jul 98	Aug 98	Sep 98	Oct-98	Nov-98		
Planned	$42,900	$42,900	$42,900	$42,900	$64,350	$64,350	$300,300	$530,000
Actual								

Based on currently authorized work:

(1) Is current funding sufficient for the current FY ? Yes

(2) What is the next Fiscal Year's funding requirement at anticipated levels $545K

(3) Have you included in the report narrative any explanation of the above data and are they cross referenced ? Yes, see 3.3.1

3.3.3 Travel and Meetings

Date	Location	Subject
2 Apr	Orlando, FL	JSIMS SNE WIPT Meeting
22 Apr	SAIC, Burlington, MA	Teleconference with Jon Watkins

3.3.4 Any Significant Changes to the Contractor Organization or Method of Operation

None.

3.3.5 Summary of Engineering Change Proposal (ECP) Status

None.